

Claims

1. In a data processing system including a display device and a processing means running an application program, a method comprising the steps of:
 - providing a user interface output controller for generating a user interface output sequence;
 - receiving an event from the application program at the user interface output controller, the event specifying a goal to be achieved by the user interface output sequence; and
 - upon receiving the event from the application program,
 - generating the user interface output sequence at the user interface output controller, the user interface output sequence achieving the goal in response to the event; and
 - executing the generated user interface output sequence at the user interface output controller so as to display the generated user interface output sequence on the display device.
2. The method of claim 1 wherein the application program and the user interface output controller are independent components of the data processing system.
3. The method of claim 1 wherein the goal specifies a plurality of actions to be performed by the user interface output sequence.
4. The method of claim 1 wherein the goal specifies a user interface output state which identifies a set of conditions that identify attributes of the user interface output state.
5. The method of claim 1 wherein the user interface output controller generates a plurality of user interface output sequences and each of the plurality of user interface output sequences includes audio, visual, and textual elements.
6. The method of claim 1 wherein the data processing system includes an operating system and wherein the user interface output controller is a component of the operating system.

7. The method of claim 1 wherein the received event identifies a goal along with a timing specification which determines the time at which the goal will be achieved.
8. The method of claim 1 wherein each of the user interface output sequences may be stored as software instructions specifying commands which generate user interface output.
9. The method of claim 1 wherein the user interface output controller invokes a user interface output script that includes a plurality of commands for achieving the goal specified by the event.
10. The method of claim 9 wherein the user interface output sequence includes user interface output states, wherein each of the user interface output states includes a set of conditions which identify attributes of that user interface output state and each of the conditions includes a value that captures one of the attributes of that user interface output state, and wherein the step of invoking a user interface output script includes the step of invoking a user interface output script that includes a plurality of commands which are to be performed by the user interface output sequence when a predefined set of conditions are true.
11. The method of claim 10 further comprising:
determining a current user interface output state which identifies the set of conditions which identify attributes of one of the user interface output states; and
generating the user interface output sequence at the user interface output controller based on the determined current user interface output state, wherein the user interface output sequence includes audio, visual, and textual elements.
12. The method of claim 1 further comprising:
providing a user interface output system for controlling the generation of the user interface output sequence;
providing a specification identifying a plurality of goal user interface output states, which identify user interface output states for the user interface output system to establish, and operators which specify actions to be performed by the user interface output sequence; and
compiling the specification at the user interface output system which results in a user interface output controller that includes a plurality of plans, each of the plans having a

series of operators, a goal user interface output state, and a start user interface output state that identifies a current user interface output state of the user interface output sequence, the operators for transforming the start user interface output state to the goal user interface output state.

13. The method of claim 12 wherein the step of compiling the specification applies a planning methodology to generate each of the plans.

14. In a data processing system including a display device and a processing means running an application program, a method comprising the steps of:

providing a user interface output system for controlling the generation of a user interface output sequence;

providing a specification identifying a plurality of goal user interface output states, which identify user interface output states for the user interface output system to establish, and operators which specify actions to be performed by the user interface output sequence;

providing a compiler for compiling the specification which results in a user interface output controller that includes a plurality of plans, each of the plans having a series of operators, a goal user interface output state, and a start user interface output state that identifies a current user interface output state of the user interface output sequence, the operators for transforming the start user interface output state to the goal user interface output state;

while the application program is running on the processing means,

providing the user interface output controller with an event received from the application program, the event identifying one of the goal user interface output states;

determining the start user interface output state of the user interface output sequence;

retrieving one of the plurality of plans based on the determined start user interface output state of the user interface output sequence and the identified one of the goal user interface output states; and

performing the series of operators provided by the retrieved plan to transform the determined start user interface output state to the identified one of the goal user interface output states so as to display the series of operators on the display device.

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15. The method of claim 14 wherein the step of providing a specification includes the steps of:

providing events which may be specified by the application program and for which the user interface output system provides user interface output sequences;

providing state variables that define attributes of each user interface output state; and

providing operators that identify actions which are used to modify the attributes of each user interface output state.

16. The method of claim 15 wherein the specification includes timing directives which determine the time at which an action is performed.

17. The method of claim 15 further comprising providing state class definitions which are hierarchical groupings of state variables.

18. The method of claim 15 further comprising providing autonomous action sequences identifying actions which are performed by the user interface output system when a current user interface output state contains predefined values for conditions which capture attributes of the current user interface output state.

19. The method of claim 14 wherein the step of compiling the specification applies a planning methodology to generate each of the plans.

20. The method of claim 19 wherein the step of applying a planning methodology to generate each of the plans includes the steps of:

selecting each of the goal user interface output states; and

for each of the goal user interface output states, selecting each of the plurality of operators in a sequence,

performing an inverse of the selected one of the operators on the selected one of the goal user interface output states; and

when the inverse of the selected one of the operators transforms the selected one of the goal user interface output states into a new user interface output state, storing the new user interface output state along with the selected one of the operators which transforms the new user interface output state into the goal user interface output state.

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21. The method of claim 20 wherein the new user interface output state is processed as a goal user interface output state.

22. In a data processing system including a display device and a processing means running an application program, a method comprising the steps of:

providing a user interface output controller for generating a user interface output sequence, the user interface output sequence including a first user interface output state and a second user interface output state, the first user interface output state and the second user interface output state each including a set of conditions representing values which capture attributes of that user interface output state;

providing operators which identify actions which transform the first user interface output state into the second user interface output state;

receiving an event from the application program at the user interface output controller, the event specifying a goal to be achieved by the user interface output sequence;

upon receiving the event from the application program, determining whether any of the conditions precede the event;

when there are conditions which precede the event, establishing the conditions which precede the event;

performing the provided operators to transform the first user interface output state into the second user interface output state, which establishes the event;

determining whether any of the conditions temporally follow the event; and

when there are conditions which follow the event, establishing the conditions which follow the event.

23. A data processing system, comprising:

a processing means for running an operating system;

a display device displaying a user interface output state;

an application program including a plurality of events, each of the events specifying goals to be achieved to transform the user interface output state;

for each of the events, an implementation of the event, the implementation including a plurality of commands which direct a plurality of actions of the user interface output state;

a user interface output controller for controlling the display of a user interface output sequence, the user interface output controller including,

means for receiving one of the events from the application program;

means for retrieving the implementation of the received one of the events, the implementation including a series of commands for achieving the goals specified by the received one of the events;

means for selecting each of the commands in the retrieved implementation; and

means for executing each of the selected commands to achieve the goal specified by the received one of the events in the user interface output sequence on the display device so as to display the user interface output sequence on the display device.

24. The system of claim 23 wherein the means for retrieving an implementation of the received one of the events further comprises means for retrieving a user interface output script.

25. The system of claim 23 wherein the means for retrieving an implementation of the received one of the events further comprises means for retrieving software instructions specifying commands to achieve the goals specified by the received one of the events.

26. A data processing system, comprising:
a display device for displaying a user interface output sequence;
a processing means for running an application program;
means for providing a user interface output system for controlling the generation of the user interface output sequence;

means for providing a specification identifying goal user interface output states, which identify user interface output states for the user interface output system to establish, and operators which specify actions to be performed by the user interface output sequence;

means for compiling the specification to generate a user interface output controller; and

means for storing the user interface output controller in memory, the user interface output controller including,

means for receiving an event from the application program, the event identifying one of the goal user interface output states;

means for determining a current user interface output state in the user interface output sequence;

means for determining a sequence of operators which transform the determined current user interface output state into the identified one of the goal user interface output states; and

means for performing the sequence of operators to transform the determined current user interface output state into the identified one of the goal user interface output states so as to display the sequence of operators on the display device.

27. The system of claim 26 wherein the received event identifies a timing specification which determines the time at which the sequence of operators are performed.

28. The system of claim 26 further comprising means for incorporating the identified timing specification into the user interface output sequence.

29. A user interface output system for controlling the generation of a user interface output sequence, comprising:

a specification for identifying goal user interface output states, which identify user interface output states for the user interface output system to establish, and operators which specify actions to be performed by the user interface output sequence;

a compiler for compiling the specification to generate a user interface output controller; and

a storage for storing the user interface output controller in memory, the user interface output controller comprising,

a receiver for receiving an event from an application program, the event identifying one of the goal user interface output states;

a first determinor for determining a current user interface output state in the user interface output sequence;

a second determinor for determining a sequence of operators which transform the determined current user interface output state into the identified one of the goal user interface output states; and

an executor for executing the sequence of operators to transform the determined current user interface output state into the identified one of the goal user interface output states so as to display the sequence of operators on a display device.

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30. The system of claim 29 wherein the received event identifies a timing specification which determines the time at which the sequence of operators are performed.

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31. The system of claim 30 further comprising a timer for determining the time at which the sequence of operators are performed.

32. A computer-readable storage medium, upon which is stored an application program and a user interface output controller for generating a user interface output sequence, the user interface output controller performing the steps of:

receiving an event from the application program, the event specifying a goal to be achieved by the user interface output sequence; and

upon receiving the event from the application program,

generating the user interface output sequence, wherein the user interface output sequence achieves the goal in response to the event; and

executing the generated user interface output sequence so as to display the generated user interface output sequence on a display device.

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